



National Aeronautics and
Space Administration



AI1-SYS-FWTS

REVISION: V2.00

RELEASE DATE: NOVEMBER 18, 2008

**ARES I-X
FAIR WEAR AND TEAR SPEC
(AVIONICS, USS, ROCS, CM/LAS)**

*The electronic version is the official approved document.
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REVISION AND HISTORY PAGE

Status (Baseline/ Revision/ Canceled)	Revision No.	Change No.	Description	Release Date
Baseline	1.00	CR AIX-0238	Initial Baseline—Note correction made to release date prior to posting following one week grace review.	11/18/2008

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1.0 SCOPE

This specification establishes hardware acceptability criteria for Avionics, Upper Stage Simulator (USS), Roll Control System (RoCS), and Crew Module / Launch Abort System (CM/LAS) equipment, parts, and assemblies exhibiting minor or cosmetic defects generally attributed to handling or usage. This includes both flight hardware and non-Shuttle GSE. Defects falling within the limits of acceptability, as outlined in this specification, are known as Fair Wear and Tear (FW&T). Defects which exceed these conditions or require repair/rework will be documented in the non-conformance system as described in section 3.

This specification is effective from hardware manufacture (for items manufactured within the IPT) or from handover to the Ground Operations IPT (for items subcontracted out) through launch, with the exception of specific items which say "KSC" or "GO IPT" (primarily addressing process, rather than acceptability).

1.1 INTENT

At a microscopic level, millions of defects and imperfections will exist in the specified hardware. Obviously, these imperfections are acceptable up to some threshold. The intent of this specification is to establish that threshold and to provide a uniform, objective approach in assessing these defects and imperfections.

1.2 PURPOSE

The purpose of this specification is to provide warehouse, receiving-inspection, inspection and engineering personnel with pre-approved definitive criteria for determining the "as-is" acceptability of parts and equipment having minor or cosmetic defects due to FW&T. Additionally, it provides information for the processing of nonconformances, including minor standard repairs in some cases.

1.3 LIMITATIONS

This specification applies only to parts and equipment for Avionics, USS, RoCS, and CM/LAS hardware. First Stage FW&T is documented in specification STW7-18060.

FW&T relief shall be granted to both installed and off-line equipment, parts, and assemblies, per the FW&T criteria defined in this specification. This document will not override the Operational Test Requirements Document (OTR) unless specifically noted in the applicable OTR.

1.4 REWORK TO DRAWING REQUIREMENTS

Rework specifically authorized by this document shall be documented in the non-conformance system, but is considered "return to print" and does not require a Material Review Board (MRB) approval. All rework not specifically authorized by this document or by the applicable drawing, will require MRB approval.

1.4.1 Corrosion Control Touch-Up Limitations

Touch-up of protective treatments and finish requirements are not addressed by this specification if any of the following conditions exist:

- Imperfection/damage is indicative of a generic paint adhesion problem

1.4.2 Raised Metal Limitations

Raised metal is permitted by this specification in some cases. An exception to this is if the raised metal is underneath cables, such that it is likely to cut the cable insulation, or is in a high-usage area that is likely

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to injure personnel, such as sharp raised metal on a hand rail. In these cases, it will be blended smooth. Rework shall be documented and dispositioned per [section 3](#).

1.4.3 Mold Impression Limitations

Mold impressions of minor damages, dents, scratches, etc. may be obtained without documentation. Personnel performing measurements of mold impressions shall be certified and shall have demonstrated proficiency using approved equipment. Mold impression data exceeding FW&T criteria shall be documented. Mold impression material may not be used on the following hardware when evaluating damages for FW&T acceptance:

- Thermal Protection System (TPS) components (e.g. - cork adjacent to RoCS thrusters)
- Internal clean systems (e.g. - internal side of fluid lines)
- Within 1 inch of a transducer sense port (e.g. - external pressure sense ports located on the exterior of the vehicle)

1.4.4 Defects in Coatings

Defects in coatings, except thermal control coatings or wiring insulation, that do not expose base metal are acceptable. Additionally, defects in coatings internal to the vehicle that expose base metal are acceptable if they meet the criteria described in the applicable section, except as noted in section 1.4.1.

1.5 DEFINITIONS

1.5.1 Fair Wear And Tear

Minor or cosmetic defects to equipment, parts, and assemblies due to manufacturing, shipping, test, and ground operational usage which do not diminish its designated performance, structural integrity, or intended function.

1.5.2 Minor Defects

Small hardware imperfections such as minor hole elongation, surface blemishes, nicks, scratches, or burred fastener heads, requiring no or minimal repair actions. Each condition is addressed in this specification, along with criteria for acceptability.

1.5.3 Cosmetic Defects

Hardware surface conditions such as stains, discoloration, scuff marks, nicks, dings, dents, requiring no repair actions.

1.5.4 System Engineer

The System Engineer is an assigned engineer within the IPT currently having custody of the affected hardware. Assignment of engineers shall be the responsibility of the IPT.

For the GO IPT, the assigned engineer is any engineer within the discipline (functional group) assigned responsibility per the engineering POC list posted on the KSC Ares I-X web page. Any issues as to which GO IPT engineering discipline is responsible shall be resolved by the USA SVE or Floor Support Engineer.

1.5.5 Primary Structure

Primary Structure is composed of those elements that contribute significantly to carrying flight, ground, and pressurization loads. This includes:

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- The external shell of the vehicle
- Flange bolts between segments
- CM/LAS internal structural members
- Fasteners connecting CM/LAS structural members
- Fasteners mounting the IS-1 access panel, RoCS modules, or external protuberances

2.0 APPLICABLE DOCUMENTS, MATERIALS, AND EQUIPMENT

2.1 GOVERNING DOCUMENTS

This specification has been approved by the Ares I-X XCB, with applicability to all Avionics, USS, RoCS, and CM/LAS hardware. Changes to this document will require Ares I-X XCB approval.

2.2 APPLICABLE MATERIALS AND EQUIPMENT

All references in table 1 to federal stock numbers (FSNs) for procurement of materials and equipment are applicable at the Kennedy Space Center (KSC).

Table 1 Applicable Materials and Equipment

Material	Specification	Source
Abrasive Paper, 400 Grit	FSN 5350-00-224-7201	KSC Central Supply / Commercial
Brush, Bristle (Assorted Sizes)	FSN 8020-XX-XXX-XXXX	
Detergent	FSN 6850-00-K25-4006	Amway
Detergent	P-D-220 TYPE II, CLASS I	
Ink, Marking	73X	Sharpee
Isopropyl Alcohol	TT-I-735 MF0004-097	
Coating, Electrically Conductive, Epoxy Paint	MB0125-070	
Tape, Gray Adhesive	No. 467	
Water, High Purity	MB0210-007-TYPE I	
Wiper, Lint Free	FSN XXXX-XX-XXX-XXXX	

3.0 DOCUMENTATION REQUIREMENTS

In general, the part or equipment will be left in the “as-is” condition and will not be refurbished to “like-new” appearance. Only the authorized repair/rework defined in this specification shall be performed. When the applicability of this document with respect to a particular defect needs clarification, the responsible engineer shall make the determination.

Conditions that exceed the criteria of this specification or are suspected of affecting safety of flight or flight integrity shall be documented and dispositioned in the non-conformance system.

Defects requiring repair/rework shall be documented and dispositioned in the non-conformance system.

The element IPT shall provide the GO IPT with a list of all previously documented and dispositioned discrepancies prior to hardware custody transfer. These items will be entered into the Ares I-X Ding Log upon or prior to custody transfer, if accepted as is or if they result in visible repair. Discrepancies and

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nonconformances reported and dispositioned by the providing IPT prior to turnover shall not be re-reported by the GO IPT as a result of future inspection.

The Ares I-X Ding Log is an on-line database being deployed to document items significant enough to require assessment against this specification (or in some cases will be found to exceed the specification and require initiation of a non-conformance). Defects that are acceptable, per the criteria defined in this specification, shall not be documented in the non-conformance system.

GO IPT personnel may take photos and record defects in the Ding Log, especially if mold impressions or other means were required to determine that a defect is acceptable. This is done primarily for documentation and to prevent having to readdress the items. It is not a requirement to document every defect, no matter how minor. To do so would be impractical, since at a microscopic level, millions of defects and imperfections will exist.

The Ares I-X Ding Log will be used to document visibly apparent indications not previously noted for hardware delivered under the Jacobs AIS contract, in order to allow the Avionics IPT to independently assess whether there could be other concerns (e.g. - shock impact). The Avionics IPT shall be notified of any Avionics related entries.

4.0 ROLES AND RESPONSIBILITIES

4.1 ALL PERSONNEL

All personnel performing processing shall be responsible for identification and documentation of defects, as described in [section 3](#).

4.2 QUALITY ASSURANCE

The quality assurance organization shall ensure that only hardware described in this specification is a candidate for FW&T evaluation and disposition, and that any minor rework/repair of defects is limited to that authorized. All work on flight hardware will be per work steps in a work authorizing document (WAD), with the exception of non-intrusive, non-hazardous assessment, such as observation or mold impressions.

4.3 SYSTEM ENGINEER

The System Engineer is responsible for clarification and applicability of specification criteria. Items requiring clarification or assessment (post hardware turnover) shall be documented in the KSC Ares I-X Ding Log, along with the name of the engineer making the assessment.

The system engineer shall be responsible for coordinating his/her assessment with Element IPT design engineering, quality assurance engineering, and/or SE&I when he/she has any question as to acceptability, especially as noted for Avionics electronic assemblies.

4.4 ELEMENT IPT & SE&I

Prior to hardware custody transfer, the Element IPT shall be responsible for all of the roles defined above in sections 4.1 through 4.3. After custody transfer, the Element IPT shall provide assessments of defects when requested.

SE&I shall provide assessments of defects when requested by any of the IPTs.

4.5 GO IPT

After custody transfer, the GO IPT shall be responsible for all of the roles defined above in sections 4.1 through 4.3.

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The GO IPT shall make all Ares I-X Ding Log data available to the Element IPTs and SE&I.

5.0 STRUCTURE FW&T

This section contains the FW&T criteria for evaluating minor defects to structure. Structure includes the vehicle skin, ladders, platforms, mounting hardware, and any other parts whose primary function is to hold the vehicle together or provide personnel access, but is not part of an assembly covered elsewhere (such as fluid components or avionics boxes). Defects meeting these criteria need not be documented in the non-conformance system unless specified.

The following paragraphs list specific structural defects which could be encountered. However, certain defects will be encountered which are not clearly within the specified criteria. In these instances, the responsible engineer will make the final determination and resolution.

5.1 MINOR OR COSMETIC IMPERFECTIONS

Nicks and scratches resulting from normal service/wear, including those with raised metal, which do not affect structural integrity, performance, or function, shall not be cause for rejection. Stains, discolorations, scuff marks, texture variations, residues, over-sprays and other foreign material which is adhering to structure surfaces shall be left “as-is” and shall not be cause for rejection. Conditions that exceed the criteria of this specification or are suspected of affecting safety of flight or flight integrity shall be documented and dispositioned as described in section 4.

5.1.1 Scratches

Scratches from normal service/wear are defined as a linear mark or deformation in a metal surface in which metal is either removed or displaced. Scratches not exceeding the depth provided in table 2 are acceptable and shall not be cause for rejection. Scratches which expose base metal on the interior of the vehicle are acceptable and do not require rework. Scratches which expose base metal on the exterior of the vehicle shall be assessed per [section 5.2](#).

Table 2 Allowable Scratch, Ding, Dent, and Nick Depth

Area	Allowable Depth (inches)
USS Segment Mating Flange	0.030
USS Outer Skin – All Except IS-1	0.060
USS Outer Skin - IS-1	0.030
USS External Protuberances	0.060 (Note 1)
USS GSE	0.100
All Other	0.010

Note 1 – Scratches on external protuberances that contain sharp raised metal shall be documented and blended smooth to remove edges. This is required in order to prevent scratch propagation.

5.1.2 Dings And Dents

A ding/dent is defined as a smooth surface depression or impression having no sharp edges, cracks, or displaced metal. Dings not exceeding the depth provided in Table 2 are acceptable and shall not be cause

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for rejection. Dings or dents, within the criteria provided, which expose base metal on the interior of the vehicle are acceptable and do not require rework. Dings or dents, within the criteria provided, which expose base metal on the exterior of the vehicle shall be assessed per [section 5.2](#).

5.1.3 Nicks

A nick is defined as a sharp depression having sharp edges and displacing base metal. Nicks not exceeding the depth provided in Table 2 are acceptable and shall not be cause for rejection. Nicks, within the criteria provided, which expose base metal on the interior of the vehicle are acceptable and do not require rework. Nicks, within the criteria provided, which expose base metal on the exterior of the vehicle shall be assessed per [section 5.2](#).

5.1.4 Raised Metal

Scratches and nicks that do not exceed the depth specified above are acceptable, even if there is raised metal as a result of metal displacement, except as noted in Table 2 or safety issues as noted in [section 1.4.2](#).

5.1.5 Tooling Marks

Tooling marks from manufacture are considered to be accepted already by the manufacturing element, regardless of the presence or lack of Material Review Board (MRB) marking and are not cause for rejection.

5.1.6 Elongated (Unthreaded) Fastener Holes

Elongated holes which fasteners attach through are acceptable in secondary structure and attaching hardware, such as cable hold-downs, railings, platforms, and hardware mounts so long as the hardware can be mounted securely. Elongated holes which attach two pieces of primary structure must be documented and dispositioned as described in [section 3](#).

5.2 DEFECTS TO PAINT / ANODIZE COATINGS

Defects in coating on the interior of the vehicle are acceptable and do not require rework, even if they expose base metal.

Defects in coating on the exterior of the vehicle, which do not expose the base metal, are acceptable and do not require rework. Loose, flaking, or missing painted finishes which do expose base metal on the exterior of the vehicle shall be reworked/touched-up with the protective finishes per drawing, if the disturbed area exceeds 10% of the total local area. This shall be measured using a local area of roughly 2 square feet; thus if more than 0.2 sq ft (28.8 sq in) is unpainted (worn or flaked) in any given 2 sq ft area, it shall be reworked. Touch-up or rework shall be documented and dispositioned per [section 3](#).

5.3 ILLEGIBLE / MISSING MARKINGS

Illegible or missing identification markings/nomenclature shall be documented and dispositioned per [section 3](#). Parts may be re-identified, if deemed necessary, by writing legibly, using a fine point Sharpee® marker.

5.4 BURRED FASTENER HEADS

*** CAUTION ***

Caution should be taken to prevent contamination by metal file shavings entering critical parts.

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Burred fastener heads which do not affect the mounting surface of hardware being installed, and are not being removed for other required repair/rework, shall not be cause for rejection. Burred fastener heads having sharp metal edges that could damage installed harnesses, or the surface of hardware being installed, shall, with proper documentation, be replaced or smoothed-up and blended with a fine file to maintain existing surface contour. Corrosion protection reapplication is not required in rework area.

5.5 CONFORMAL COATING AND GROUNDING STRAPS

Defects to soft conformal coating that do not allow moisture penetration shall not be cause for rejection. Defects on grounding straps, such as discoloration, nicks, and broken strands shall not be cause for rejection, unless more than 10% of the strands are broken.

5.6 OPEN TOOLING HOLES OR DRAIN HOLES

Open tooling holes or drain holes shall be left “as-is” with no further action required.

5.7 SURFACE OXIDATION ON CRES FASTENERS

Surface oxidation (rust looking appearance) commonly found on corrosion resistant steel (CRES) fasteners, is acceptable and requires no rework.

5.8 SURFACE OXIDATION ON CORROSION RESISTANT PARTS (CRES, INCONEL, TITANIUM)

Surface oxidation on corrosion resistant parts is acceptable “as-is” and requires no rework, provided no indications of pitting or cracking are found.

5.9 DRY FILM LUBRICATION

Dry film lubrication (DFL) when first applied will normally have a flat gray appearance. As the DFL surface is contacted or burnished, the DFL may tend to take on a glossy, black, or polished metal appearance. Sometimes such surfaces appear to be bare metal. This condition is acceptable.

DFL overspray or missing/flaking/peeling DFL are also acceptable.

6.0 ELECTRICAL / ELECTRONIC ASSEMBLIES

This section contains the FW&T criteria for evaluating minor or cosmetic external defects of the electrical /electronic assemblies (“black boxes”). Defects meeting these criteria need not be documented in the non-conformance system unless repair/touch-up is specified. However, the Ares I-X Ding Log will be used to document visibly apparent indications not previously noted for hardware delivered under the Jacobs AIS contract, in order to allow the Avionics IPT to independently assess whether there could be other concerns (e.g. - shock impact). The Avionics IPT shall be notified of any Avionics related entries.

***** CAUTION *****

All electrical/electronic boxes shall be considered sensitive to electrostatic discharge (ESD) and by “best shop practice” shall be adequately protected to prevent degradation or damage to hardware any time electrical connectors are uncapped or if the box is opened. (There is currently no plan to open any box at KSC, unless done by the vendor for repair). Reference the ANSI/ESD S2020 workmanship standard.

6.1 BURRED FASTENER HEADS

***** CAUTION *****

Caution should be taken to prevent contamination by metal file shavings entering the unit.

Burred fastener heads which do not affect the mounting surface of the unit, and are not being removed for other required repair/rework, shall not be cause for rejection. Burred fastener heads having sharp metal

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edges that could damage installed harnesses, which are not being removed for the required installation, or the surface the unit mounts to, shall, with proper documentation, be replaced or smoothed-up and blended with a fine file to maintain existing surface contour. Corrosion protection reapplication is not required in rework area.

6.2 MINOR HOLE ELONGATION

Minor elongations of attach holes not to exceed 0.010 inch in diameter in covers, brackets, and terminal boards shall be deemed to have been covered on “initial build” regardless of MRB identification (or lack of) and shall not be cause for rejection or NC initiation.

6.3 CONNECTOR DEFECTS

6.3.1 Pins and Sockets

All connector inspection shall be done 100% visually. Connector inspection magnification shall be from 4X to 10X in accordance with NASA-STD-8739.4 (paragraph 20.2, Magnification Aids).

Inspect both pins and sockets. Pins may not be misaligned, bent, scratched, bowed, corroded or recessed. A bent pin is a pin that is not straight from the base to the tip by more than 0.010 inches. A misaligned pin is where the distance between pin tips is misaligned more than 0.010 inches. If a pin is bent or misaligned, it can be straightened using the corresponding socket, as long as it does not contain more than one bend (dog-leg) or any evidence of deformation or cracking. Should cracking, deformation, or a dog-leg exist, pin replacement will be required. If a pin is straitened, it must be re-inspected after straightening. Rework to straighten or replace a bent pin will be documented and dispositioned per [Section 3](#).

Inspect grommet for tears or holes that are overly enlarged.

6.3.2 Other Surfaces

Defects, such as minor scrapes, scratches, chips, and discoloration on the faces of connectors, which do not affect the connectors' function, mating, or moisture sealing characteristics, shall not be cause for rejection or NC initiation. Cleaning may be accomplished per [section 6.4](#), if particulate or residue is present. Minor nicks, scratches, flat spots on connectors/backshells, such as those caused by normal handling during mate/remate/rework which do not affect the connectors' function shall not be cause for rejection, NC initiation, or repair.

See [Section 7](#) for FW&T criteria for defects to wire harness assemblies.

6.4 ILLEGIBLE / MISSING MARKINGS

Illegible or missing identification markings/nomenclature shall be documented and dispositioned per [section 3](#). Parts may be re-identified, if deemed necessary, by writing legibly, using a fine point Sharpee® marker.

6.5 MINOR DAMAGE

Minor nicks, scratches, and abrasions which do not affect the function of an electrical/electronic assembly, shall not be cause for rejection. However, most of these assemblies are owned by the Avionics contractor and will not be transferred to the government. This includes the MDAUs, RDAUs, RRGUs, FTINU, and all black boxes mounted on the First Stage Avionics Module (FSAM). For these boxes, if there is any question as to whether minor damage might affect the function of the unit (i.e. – indicates an impact to the box), the Avionics IPT engineer will make the final determination.

The Avionics boxes installed in the Upper Stage are listed in Table 3.

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Table 3 Avionics Boxes Installed in the Upper Stage

Avionics Box	Part Number	Location
MDAU-5	63-10001-5	US-7
MDAU-7	63-10001-7	US-7
RDAU-8	63-10001-8	US-7
RDAU-6	63-10001-6	US-1
RRGU	22-62220-5	US-7
FTINU	58-04650	US-1

Support structure where black boxes are mounted is considered structure and addressed per section 5.

6.6 DEFECTS TO PAINT/ANODIZED COATINGS

Paint/primer splatters/overspray, custom markings, stains, or discoloration, which do not affect the function of an electrical/electronic assembly, shall not be cause for rejection. Complete refinishing will not be done solely to produce a “like-new” (per drawing) appearance.

6.7 CONNECTOR DUST CAP / LANYARD

Connector dust caps with a damaged/broken lanyard shall be documented, dispositioned per [section 3](#), and replaced per drawing requirements.

6.8 CONNECTOR SAFETY WIRE

Damaged or missing safety wire on connectors (if required per drawing) shall be documented, dispositioned per [section 3](#), and replaced per drawing requirements.

6.9 APPEARANCE

Dust, dirt, and lint shall be removed from electrical/electronic assemblies, as practical, by vacuum cleaning. Grease, oil, tape residue, etc., shall be removed, as practical, from electrical/electronic assemblies, using a clean, lint free wipe, dampened with isopropyl alcohol. No other solvent shall be used.

7.0 WIRE HARNESS ASSEMBLIES

This section contains the FW&T criteria for evaluating minor or cosmetic external defects to the wire harness assemblies. Defects meeting these criteria need not be documented in the non-conformance system unless specified. However, the Ares I-X Ding Log will be used to document visibly apparent indications not previously noted for hardware delivered under the Jacobs AIS contract, in order to allow the Avionics IPT to independently assess whether there could be other concerns (e.g. - shock impact). Defects and damage more serious than that described herein shall be documented and dispositioned per [section 3](#).

7.1 BURRED FASTENER HEADS

Burred fastener heads on strain relief or harness clamps shall not be cause for rejection or repair.

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7.2 CONNECTOR DEFECTS

7.2.1 Pins and Sockets

All connector inspection shall be done 100% visually. Connector inspection magnification shall be from 4X to 10X in accordance with NASA-STD-8739.4 (paragraph 20.2, Magnification Aids).

Inspect both pins and sockets. Pins may not be misaligned, bent, scratched, bowed, corroded or recessed. A bent pin is a pin that is not straight from the base to the tip by more than 0.010 inches. A misaligned pin is where the distance between pin tips is misaligned more than 0.010 inches. If a pin is bent or misaligned, it can be straightened using the corresponding socket, as long as it does not contain more than one bend (dog-leg) or any evidence of deformation or cracking. Should cracking, deformation, or a dog-leg exist, pin replacement will be required. If a pin is straitened, it must be re-inspected after straightening. Rework to straighten or replace a bent pin will be documented and dispositioned per [Section 3](#).

Gold discoloration at the bottom of socket wells is normal and shall not be cause for rejection. Cleaning may be accomplished per [section 7.3](#).

Connector pins that have what appear to be holes or dimples in the tip are normal and shall not be cause for rejection or NC initiation.

Inspect grommet for tears or holes that are overly enlarged.

7.2.2 Other Surfaces

Defects, such as minor scrapes, scratches, chips, and discoloration on the faces of connectors, which do not affect the connectors' function, mating, or moisture sealing characteristics, shall not be cause for rejection or NC initiation. Minor nicks, scratches, flat spots on connectors/backshells, such as those caused by normal handling during mate/remate/rework which do not affect the connectors' function shall not be cause for rejection, NC initiation, or repair.

7.2.3 Recessed Connector Contacts

When a contact has been determined to be “recessed” (not locked in place) the contact may be reseated using the appropriately sized insertion tool and isopropyl alcohol for lubrication. Re-seating activities shall be documented and dispositioned per [section 3](#)

7.2.4 Loose Backshells

Loose backshells noted on connectors can be reworked, however; connector/backshell manipulation shall NOT be done solely to verify if the backshell is “loose”. Rework shall be accomplished only when the connector is opened/demated for another reason, unless a gross looseness is visually detected or safety of flight is suspected. Back shell rework activities shall be documented and dispositioned per [section 3](#).

7.3 ILLEGIBLE / MISSING MARKINGS

Illegible or missing identification markings/nomenclature shall be documented and dispositioned. per [section 3](#). Parts may be re-identified, if deemed necessary, by writing legibly, using a fine point Sharpee® marker or Gray adhesive backed tape, No. 467, as an alternative to rubber-stamping. The tape shall be marked on the painted side. Tape shall be applied to a metal area that has been cleaned with a lint free wipe lightly dampened with TT-I-735 isopropyl alcohol. The surface shall be allowed to dry for a minimum of 20 minutes before tape application.

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7.4 WIRE INSULATION COATINGS AND CABLE SHIELD JACKET

7.4.1 Wire Insulation (Top/Color Coat) Discrepancies

Appearance of small wrinkles, scratches, scrapes, voids, blisters, bubbles, or crazing of the color coating is acceptable provided there is no damage to the Kapton insulation (i.e. no topcoat is required). Discrepancies shall be inspected with a good light and 10x magnification. Only those discrepancies found to be outside the allowables defined in this section shall be documented and dispositioned per [section 3](#).

7.4.2 Cable Shield Jacket Radial Cracks (Or Splits)

Radial cracks (or splits) in the shield jacket of shielded/jacketed cable, that have not damaged (broken) the underlying shield strands or damaged the primary insulation/conductor, shall be inspected as outlined below.

The fact that the shield strands are not aligned evenly is not considered to be damage. The damaged area shall be inspected with a good light and 10x magnification. No clamps, spot ties, or other harness restraints shall be removed to inspect the cable. The cable shall not be flexed or manipulated to assess the damage. Do not probe the shield strands. After determination has been made that the crack/split is limited to the jacket only and the crack/split is in a "harness", (a grouping of two or more wires/cables), with restraints on either side of the split, no repair is required.

If the split is on an individual cable, or in a section of wiring which is subject to flexing during the mate/demate process, the cable shall have abrasion protection applied and documented and dispositioned per [section 3](#).

Cables with broken shield strands, exposed shielding greater than 3/8 inches, or primary insulation or primary conductor damage is not acceptable and shall be documented and dispositioned per [section 3](#).

Cables with damaged (broken strands) shield braid shall be evaluated and repaired per existing repair procedures and shall be documented and dispositioned per [section 3](#).

7.5 WIRE HARNESS RESTRAINTS

Harnesses shall be mounted and protected in accordance with AI1-ICD-A2V Ares I-X Avionics Interface Control Document paragraphs 3.5.1.1.2.1 and 3.5.1.1.2.2 which is summarized as follows: Harness minimum bend radius requirement is 6x overall bundle diameter or 10x the outside diameter of the largest wire, the maximum spacing between harness attachment provisions is 16 inches and harnesses are to be protected against chaffing. See AI1-ICD-A2V document for details.

Discoloration of spot-ties, clamp cushions, or other restraint devices shall not be cause for rejection. Frayed or missing harness restraints, or damaged clamp cushions exposing bare metal on the surface interfacing the cable or the edge of the clamp shall be documented and dispositioned per [section 3](#) and replaced per drawing requirements. If spot-ties, clamps, and other restraint devices show damage or are being replaced, and wiring under them or restrained by them shall be inspected for evidence of damage.

7.6 CONNECTOR DUST CAP / LANYARD

Connector dust caps with a damaged/broken lanyard and not attached to a line replaceable unit (LRU) shall be documented and dispositioned per [section 3](#) and replaced per drawing requirements. Missing or damaged dust caps shall be reinstalled or replaced per the drawing requirements.

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7.7 GROMMETS

Grommets for abrasion protection of wire harness which are loose, damaged, or missing shall be documented and dispositioned per [section 3](#) and replaced per drawing requirements.

7.8 CONNECTOR SAFETY WIRE

Damaged or missing safety wire on connectors (if required on drawing) shall be documented and dispositioned per [section 3](#) and replaced per drawing requirements.

7.9 RECEPTACLE STAKING

Damaged or missing connector staking may be re-bonded per drawing requirements. This rework shall be documented and dispositioned per [section 3](#).

7.10 CONNECTOR(S) / BACKSHELL(S) OXIDATION

Oxidation, residue, minor pitting, and lack of some or all of the electrolyses nickel plating on the connector(s)/backshell(s) shall not be cause for rejection, NC initiation, or repair. Residue may be wiped with a clean lint free wipe dampened with isopropyl alcohol. No other solvent shall be used. Minor pitting is defined as pitting that does not extend through the entire depth of the backshell casing.

7.11 UNSIGHTLY WIRE INSTALLATIONS

Wiring that is not properly combed or routed shall be evaluated for safety of flight only. Rework shall not be done solely to produce a “like-new” (per drawing) appearance.

7.12 TOUCH-UP OF CONFORMAL COATING

Minor damaged portions of conformal coating may be touched-up. This operation is considered to be “return to print” and shall be documented and dispositioned per [section 3](#).

7.13 HARNESS SHIELD OVER-BRAID

The primary purpose of harness shield over-braid is to carry the shielding of all the harness cables directly to the connector backshell. The overbraid is secured to the connector backshell using tape and to the harness using tape and spot ties.

Missing or peeling tape and/or missing spot ties shall be documented and dispositioned per [section 3](#). Over-braid shield strands not aligned evenly is acceptable. Broken strands shall be documented and dispositioned per [section 3](#). The area shall be inspected with a good light and 10x magnification. At no time shall clamps, spot ties or other harness restraints be removed to inspect the harness. The harness shall not be flexed or manipulated to assess the damage.

8.0 INSTRUMENTATION

This section contains the FW&T criteria for evaluating minor or cosmetic external defects to instrumentation hardware. Defects meeting these criteria need not be documented in the non-conformance system unless specified herein. However, the Ares I-X Ding Log will be used to document visibly apparent indications not previously noted for hardware delivered under the Jacobs AIS contract, in order to allow the Avionics IPT to independently assess whether there could be other concerns (e.g. - shock impact). Defects and damage more serious than that described herein shall be documented and dispositioned per [section 3](#).

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8.1 TRANSDUCERS

Transducers exhibiting non-critical surface (casing, connector exterior, etc) nicks, dings, and scratches resulting from normal service/wear which do not affect structural integrity, performance, or function shall not be cause for rejection.

8.2 PASTE ON SENSOR CONFORMAL COATING DEFECTS

Defects, such as minor scrapes, scratches, chips and peeling of conformal coating applied over temperature or strain gage sensors can be reworked provided the underlying sensor is without damage. Manually remove any loose coating. Reapply coating per drawing. Coating rework activities shall be documented and dispositioned per [section 3](#).

9.0 FLUID SYSTEM COMPONENTS (ROCS)

This section contains the FW&T criteria for evaluating minor or cosmetic defects to fluid system components, such as the exterior body of tanks, plumbing, valves, regulators, relief valves, and thrusters. Defects meeting these criteria shall not be cause for rejection. Defects and damage more serious than that described herein shall be documented and dispositioned per [section 3](#).

9.1 MINOR IMPERFECTIONS

Components and associated piece parts exhibiting nicks, dings, and scratches resulting from normal service/wear, including those with raised metal, which do not affect structural integrity, performance, or function shall not be cause for rejection. Any damage that exceeds the limits of FW&T shall be documented and dispositioned per [section 3](#). Any questionable defect shall be documented for further disposition.

9.1.1 Scratches

Scratches from normal service/wear is defined as a linear mark or deformation in a metal surface. Scratches not exceeding a depth of 0.005 inch, even if base metal is exposed, which are not located in critical areas/surfaces as listed in 9.3, are acceptable.

9.1.2 Dings And Dents

A ding/dent is defined as a smooth surface depression or impression having no sharp edges, cracks, or displaced metal. Dings not exceeding a depth of 0.005 inch, and which are not located in critical areas/surfaces as listed in 9.3, are acceptable.

9.1.3 Nicks

A nick shall be defined as a sharp depression having sharp edges and displacing base metal. Nicks not exceeding a depth of 0.005 inch, and which are not located in critical areas/surfaces as listed in 8.3, are acceptable.

9.1.4 Raised Metal

Scratches and nicks that do not exceed the depth specified above are acceptable, even if there is raised metal as a result of metal displacement, except for safety issues as noted in section 1.4.2.

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9.2 ILLEGIBLE / MISSING MARKINGS

Illegible or missing identification markings/nomenclature shall be documented and dispositioned per [section 3](#). Parts may be re-identified, if deemed necessary, by writing legibly, using a fine point Sharpee® marker.

9.3 CRITICAL FEATURES / SURFACES

Critical features/surfaces listed below, and 0.200 inch beyond each surface area in all directions must meet their respective drawing requirements. Any damage other than minor staining or discoloration shall be documented and dispositioned per [section 3](#).

- Mating/Sealing Surfaces
- Threaded/Splined Surfaces
- Thruster nozzle interior
- Propellant Tanks
- Tubing

9.4 DRY FILM LUBRICATION

Dry film lubrication (DFL) when first applied will normally have a flat gray appearance. As the DFL surface is contacted or burnished, the DFL may tend to take on a glossy, black, or polished metal appearance. Sometimes such surfaces appear to be bare metal. This condition is acceptable.

DFL overspray or missing/flaking/peeling DFL are also acceptable.

10.0 ECS DUCTS

This section contains the FW&T criteria for evaluating minor or cosmetic external defects to Purge Air Ducts. Defects meeting these criteria need not be documented unless specified. Defects and damage more serious than that described herein shall be documented and dispositioned per [section 3](#).

10.1 MINOR ABRASIONS

Minor abrasions and nicks on the outer surface, not extending through the wall, are acceptable “as-is”, even if there is raised metal, except for safety issues as noted in [section 1.4.2](#).

10.2 DENTS

Permitted dents in USS ECS piping, that are acceptable as is, are defined by the size of the ECS piping per table 3.

Table 4 ECS Duct Dent Allowable

Pipe Diameter (in)	Max Dent Depth (in)	Max Dent Length (in)	Restriction	Quantity of Dents Permitted Per Pipe Run
14	0.7	6.2	2%	2
8	0.4	3.5	2%	1 or
6	0.3	2.6	2%	1 or
4	0.2	1.7	2%	1 or

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This means that for the 14-in. pipe, dents shall not exceed 0.7-in. deep by 6.2-in. long (<2% flow restriction), each, and there can be up to a total of two (2) dents of that size in the entire length of the 14-in. diameter ECS piping in USS. In addition to the two dents in the 14-in. ECS piping, one (1) dent, equaling up to a total of 2% flow restriction, in one of the 8-in., 6-in., **or** 4-in. diameter sections of the ECS piping is acceptable as is. This gives a total flow restriction of 2% for the first 14-in. pipe dent, 2% for the second 14-in. pipe dent, and 2% for the dent in, for example, the 6-in. section of piping for a total of 6% restriction.

This implies that any combination of dents, not to exceed the permitted quantity of dents in any one pipe size, up to a total of 6% is acceptable as is. One example of this would be one 2% dent in the 14-in. pipe, one 2% dent in the 6-in. pipe and one 2% dent in the 8-in. section. This example has a total of 6% and therefore is acceptable as is because it did not exceed the 6% or the number of permitted dents.

Note that three (3) dents of 2% restriction in the 14-in. piping is **not** acceptable because it exceeds the number of permitted dents for the 14-in. piping. In this case, the worst dented section of 14-in. piping would be replaced with a new, undented piece of 14-in. diameter piping or repaired so that it no longer is dented.

10.3 COATING DEFECTS

Defects, such as minor scrapes, scratches, chips, and peeling of coating/paint applied over ECS Ducts are acceptable “as-is”.

11.0 GROUND SUPPORT EQUIPMENT (GSE)

Shuttle owned GSE will be handled according to Shuttle processes and standards, including documentation and repair of discrepancies. This spec applies only to GSE that is built or provided specifically for Ares I-X.

Ares I-X unique GSE is intended for use only for this single mission. As such, cosmetic damage up to and including loss of corrosion control is acceptable, so long as it does not impact the intended function of the hardware.

All acceptable Fair Wear and Tear described in previous sections also apply to Ares I-X GSE. In addition, acceptable FW&T is extended for GSE as described below.

11.1 GSE STRUCTURAL IMPERFECTIONS

Components and associated piece parts exhibiting nicks, dings, and scratches resulting from normal service/wear, including those with raised metal, which do not affect structural integrity, performance, or function shall not be cause for rejection. Any damage that exceeds the limits of FW&T shall be documented and dispositioned per [section 3](#).

Nicks, dings, and scratches to non-critical structure are acceptable, even if bare metal is exposed. Non-critical structure is any structure which is non-load-bearing or carries only a minimal load. An example would be the frame on a valve panel, which is made from relatively rigid steel but carries only the weight of the components in the panel.

Nicks, dings, and scratches to critical structure (e.g. – lifting hardware) up to 0.010 inches deep are acceptable, even if bare metal is exposed.

11.2 GSE ELECTRICAL CABLES

Damage or discoloration to GSE electrical cable insulation is acceptable, so long as no conductors are exposed. However, if a cable is crushed or crimped (bent too sharply), it is possible that conductor

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damage could have occurred even though not exposed. Therefore, crushing or crimping shall be documented and dispositioned per [section 3](#).

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APPENDIX A: ACRONYMS AND ABBREVIATIONS AND GLOSSARY OF TERMS

A1.0 ACRONYMS AND ABBREVIATIONS

A2.0 GLOSSARY OF TERMS

Term	Description
	.

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APPENDIX B: OPEN WORK

B1.0 TO BE DETERMINED

Table B1-1 lists the specific To Be Determined (TBD) items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBD item is numbered based on the section where the first occurrence of the item is located as the first digit and a consecutive number as the second digit (i.e., **<TBD 4-1>** is the first undetermined item assigned in Section 4 of the document). As each TBD is solved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBDs will not be renumbered.

Table B1-1 To Be Determined Items

TBD	Section	Description

B2.0 TO BE RESOLVED

Table B2-1 lists the specific To Be Resolved (TBR) issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBR issue is numbered based on the section where the first occurrence of the issue is located as the first digit and a consecutive number as the second digit (i.e., **<TBR 4-1>** is the first unresolved issue assigned in Section 4 of the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBRs will not be renumbered.

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Table B2-1 To Be resolved Items

TBD	Section	Description